1926

FROM

THE NEW ZEALAND

JOURNAL OF SCIENCE AND TECHNOLOGY,

VOL. VIII, No. 4, pp. 228–32, 1926.

# DEVELOPMENT OF *LYCOPERDON DEPRESSUM* (FUNGI).

OF MYCOLOGY

BY

G. H. CUNNINGHAM,

Government Mycologist, Department of Agriculture, Wellington, New Zealand.

WELLINGTON, N.Z.

W. A. G. SKINNER, GOVERNMENT PRINTER.

—

1926.

FROM

THE NEW ZEALAND

JOURNAL OF SCIENCE AND TECHNOLOGY,

VOL. VIII, No. 4, pp. 228–32, 1926.

# DEVELOPMENT OF *LYCOPERDON DEPRESSUM* (FUNGI).

BY

G. H. CUNNINGHAM,

Government Mycologist, Department of Agriculture, Wellington, New Zealand.

WELLINGTON, N.Z.

W. A. G. SKINNER, GOVERNMENT PRINTER.

—

1926.

# DEVELOPMENT OF *LYCOPERDON DEPRESSUM* (FUNGI).

By G. H. Cunningham, Government Mycologist, Department of Agriculture, Wellington, N.Z.

*Lycoperdon depressum* Bon. is the commonest species of this genus found in New Zealand, and has been recorded in addition from Europe, South Africa, and Australia.

It appears during the spring and autumn months in pastures, where it is conspicuous on account of its bright colour, and because of its frequent habit of growing in rings. Plants grow in small groups, often caespitose; consequently it is a simple matter to obtain abundant immature specimens in the vicinity of mature plants.

## Structure of the Mature Plant.

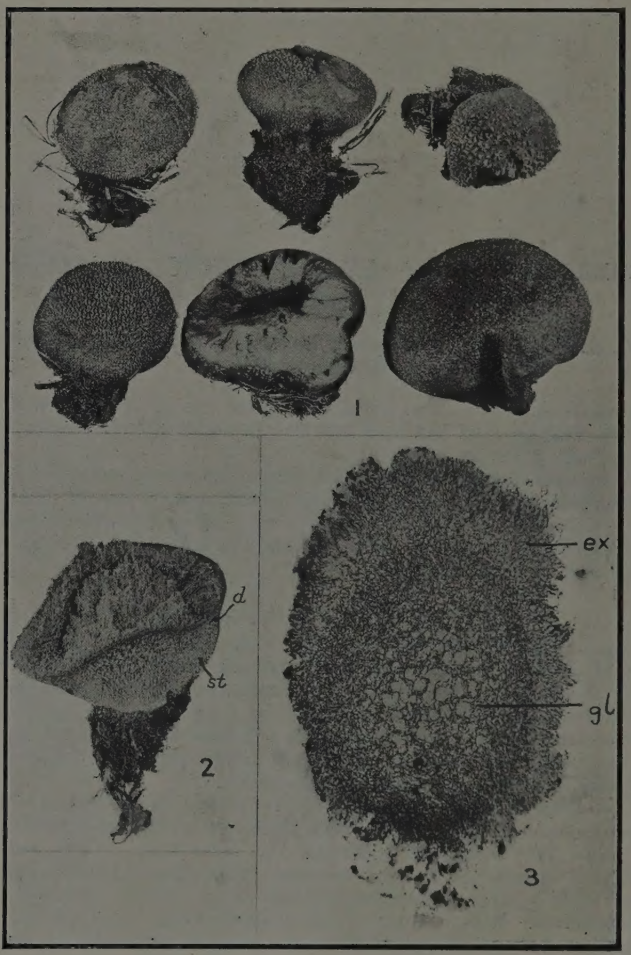
Mature plants vary considerably in shape, for in the same collection may be plants which are subglobose, pyriform, crucibuliform, or urceolate. Each plant consists of a peridium, enclosing the gleba—of capillitium and spores—and the lower third is occupied by a prominent persistent cellular sterile base, separated from the gleba by a distinct diaphragm (fig. 2).

The peridium consists of two definite tissues—an outer fugacious exoperidium, and an inner persistent endoperidium.

The exoperidium is wanting in mature plants, but is evident in plants before rupture of the apex has taken place. It is composed of two groups of tissues not organically separable, the outer being of the nature of numerous spinous or warted processes, often cruciately arranged; the inner being a layer approximately 1 mm. thick, closely appressed to the endoperidium. Both consist of pseudoparenchyma, and, as the plant matures, fall away in irregular flakes, the warts being the first to disappear.

The endoperidium becomes exposed by the flaking-away of the exoperidium, and is then seen to be a stout membranous brown persistent structure. At first it is ruptured apically by a small circular pore or stoma, but shortly the greater portion of the apex disappears, when the gleba becomes exposed (fig. 1).

The capillitium consists of very numerous, long, sparingly septate, sparsely branched, thick-walled hyphae attached to the inner wall of the endoperidium (fig. 2). The spores are minute, 3–5 $\mu$ in diameter, olivaceous, and finely and closely verrucose.




[*Figs. 1 and 2, G. H. Cunningham, photos; fig. 3, H. Drake, photo.*

FIG. 1.—Mature plants of *Lycoperdon depressum* Bon. × ½. Showing the variable nature of the exoperidium.

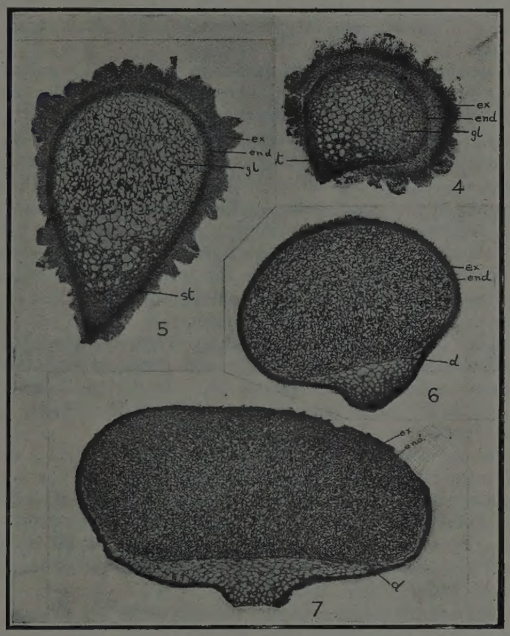
FIG. 2.—Section through a mature plant. Natural size. Showing the prominent sterile base (*st*), diaphragm (*d*), and capillitium.

FIG. 3.—Section through a developing plant. × 35. Showing the primordia of exoperidium (*ex*) and gleba (*gl*).

## DEVELOPMENT.

The following account is based on a series of twenty stages, ranging in size from 2 mm. diameter to maturity.

Plants first become noticeable as minute nodular swellings on the upper surface of the mycelium contiguous to the mature plants. At this stage they are white, soft, and elliptical or subpyriform, being about 2 × 1·5 mm.




[*H. Drake, photor.*

FIG. 4.—Section through a developing plant. × 10. Showing the definite exoperidium (*ex*), primordium of the endoperidium (*end*), gleba (*gl*), and sterile base (*st*).

FIG. 5.—Section through a developing plant. × 10. Showing the irregular nature of the exterior of the exoperidium (*ex*), definite endoperidium (*end*), commencement of the proliferation of tramal plates of the gleba (*gl*), and sterile base (*st*).

FIG. 6.—Section through a developing plant. × 3. Showing great development of tramal plates, the well-defined exoperidium (*ex*), endoperidium (*end*), developing diaphragm (*d*), and sterile base.

FIG. 7.—Section through developing plant. × 2½. Showing the commencement of the flaking-away of the exoperidium following the commencement of the thickening of the endoperidium. Note the well-developed diaphragm (*d*).

diameter. A section through such a plant shows it to be composed entirely of intricately woven, septate, branched hyphae with a diameter of 4–5 $\mu$. Shortly after the peripheral hyphae become more densely septate, and the individual cells become inflated, lose their contents, and form a

pseudoparenchyma—the primordium of the exoperidium (fig. 3, *ex*). The enclosed tissue gives rise to the endoperidium, gleba, and sterile base.

*Development of the Exoperidium.*—This arises as a layer on the periphery of the primordium of the plant (figs. 3–6, *ex*). Even at this early stage it becomes pseudoparenchymatous, and this condition persists throughout. It becomes thicker as development proceeds, and the cells become more firmly attached to one another by partial gelatinization of the walls, save at the periphery of the plant. Here growth is irregular, resulting in the appearance of irregular spinous processes so characteristic of the young plant (fig. 5).

Growth continues until the exoperidium becomes 3–4 mm. thick, when it becomes covered with groups of partially collapsed cells, giving to the exterior its warted appearance. As the plant nears maturity the exoperidium becomes fissured by rapid growth of the endoperidium; portions then flake away irregularly, finally exposing the endoperidium.

*Development of the Endoperidium.*—This appears first as a loosely-woven layer of hyphae of the same nature as those forming the primordium of the gleba, lying between the gleba and the exoperidium (fig. 4, *end*). When plants are about 6 mm. diameter the hyphae become arranged with their long axes predominantly radial. On the outer side the endoperidium is closely appressed to the exoperidium; on the inner it merges imperceptibly with the tissues of the gleba and sterile base.

It gradually becomes more densely interwoven, and thick-walled hyphae of the capillitium type appear within it, also arranged with their long axes predominantly radial. When plants are about two-thirds the size of the average mature plant these thick-walled hyphae replace those of the primordial type.

Then follows a period of increased growth until the endoperidium (which till now ranges in thickness from 0·25 mm. to 0·5 mm.) becomes 1 mm. or more in thickness, save at the apex, where this secondary thickening does not take place. Finally a small irregular aperture (the stoma) appears near the apex, through the tearing-apart of the hyphae of this region, and this is followed shortly by the dissolution of the greater part of the upper portion of the endoperidium.

*Development of the Gleba.*—In the mature gleba are present spores and capillitium (termed collectively the "gleba") and a prominent sterile base. The glebal primordium becomes noticeable when the plants are about 2 mm. diameter, appearing then as a core of undifferentiated closely-woven hyphae, surrounded by the pseudoparenchymatous exoperidium. Soon appear throughout this region small globose or irregular cavities (fig. 3, *gl*). Towards the base the hyphae become more compacted and assume a parallel arrangement, indicating the region of the sterile base (fig. 3).

The cavities of the gleba enlarge, and the hyphae between become compacted into plates, termed "tramal" plates (fig. 4). These become thinner and the cavities larger, until the whole region within the peridium (save the sterile base) consists of numerous thin plates enclosing large and somewhat regular cavities.

Next the plates begin to thicken by local growth of the hyphae of which they are composed, and a rapid proliferation of plates follows (fig. 5), so that the glebal cavities become divided into very numerous smaller and more irregular ones. Numerous basidia appear on the plates, but are not yet arranged in a definite palisade. No spores are yet present. Plants are now about 8 mm. diameter.

A more definite arrangement of the hyphae of the plates occurs, and the central hyphae assume a parallel appearance; those on the periphery become arranged as a palisade surrounding the cavities. Finally each cavity becomes enclosed within a dense palisade of basidia. The hyphae of the central portion of each plate become gelatinized and firmly compacted, save at the junction of one plate with another, where interspaces occur. A short period of spore-production ensues when plants are about 16 mm. diameter, during which the plates become thinner and the cavities larger. Finally the plates break up and fall away.

Each basidium produces 4 spores (though 2–3-spored forms are not uncommon) on long and slender sterigmata; after formation the spores are detached and the basidium collapses. The spores are at first smooth, but become finely and closely verrucose.

About the time of the commencement of the breaking-up of the tramal plates, hyphae from the endoperidium (of the capillitium type, being thick-walled and sparingly branched) grow out from the endoperidium into the cavity of the gleba, following for the most part the inner portions of the glebal plates. They develop in large numbers, so that soon the whole cavity of the gleba becomes filled with them (fig. 2).

*Development of the Sterile Base.*—The first differentiation of the sterile base occurs at the base of the developing plants when these are about 3 mm. diameter (fig. 3). Here the hyphae of the primordium of the gleba become closely compacted, arranged in palisade fashion, and assume a vertical position. This area becomes denser, the hyphae become partly gelatinized, and give rise to a definite stem-like tissue. Small cavities now appear in this region (fig. 4) similar to those of the gleba, and each becomes lined with a tissue resembling a palisade of large basidia, save that the cells are pseudoparenchymatous. The plates between the cavities are composed of hyphae similar to those of the primordium of the gleba. Finally the plates become thinner, and a well-marked diaphragm appears (fig. 6, *d*), being formed of hyphae from the plates of the sterile base, arranged with their long axes parallel with the glebal cavity. The diaphragm is sharply delimited from the glebal cavity by both its structure and arrangement (fig. 7). Plants are now about 8 mm. diameter.

The cavities of the sterile base become larger, and the plates between them thinner, and in the latter appear hyphae of the capillitium type, arising from the hyphae in the centre of each plate. They are especially numerous in the tissue of the diaphragm, which now assumes an appearance similar to that of the endoperidium and merges imperceptibly with it. The sterile base persists in this condition throughout the lifetime of the plant, and, owing to its tough nature, is, together with the endoperdium, often the only tissue remaining.

## CYTOLOGY.

Owing to the exceeding fineness of the nuclei, and to the intricately interwoven nature of the hyphae, it has been difficult to ascertain whether the individual cells are uninucleate or binucleate; but it would appear they are binucleate, for each septum appears to divide a pair of nuclei. A fusion nucleus is formed in the basidium in the usual manner, by fusion of two nuclei, and this behaves as in certain other members of the Basidiomycetes, four nuclei being produced as the result of two successive divisions. These nuclei migrate into the developing spores, and there each undergoes division, so that the mature spore is seen to be binucleate.

[100/6/26—4248